May 9, 1944. W. W. GROVES 2,348,679

PUMP

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Fig. 1.

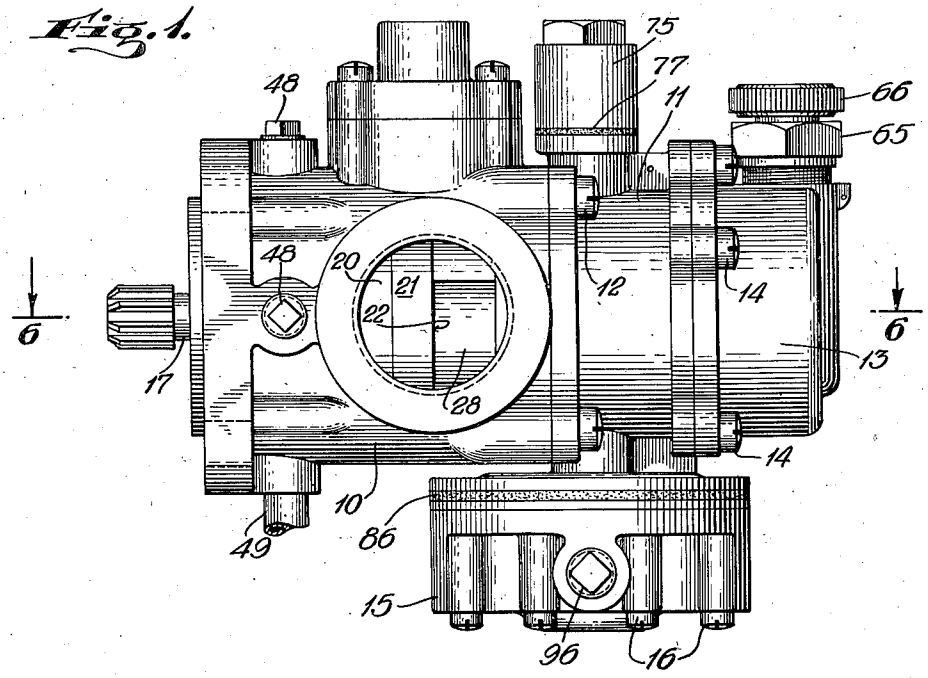
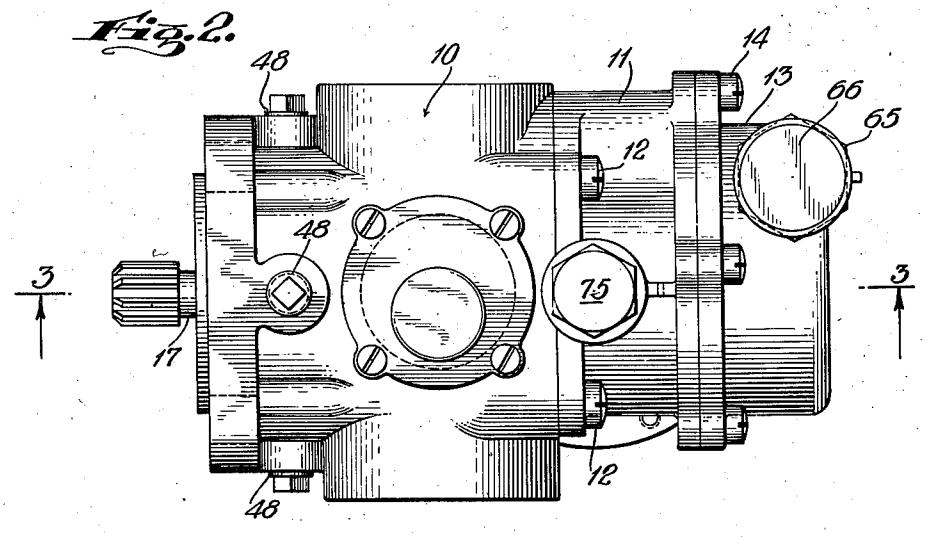


Fig. 2.



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Fig. 3.

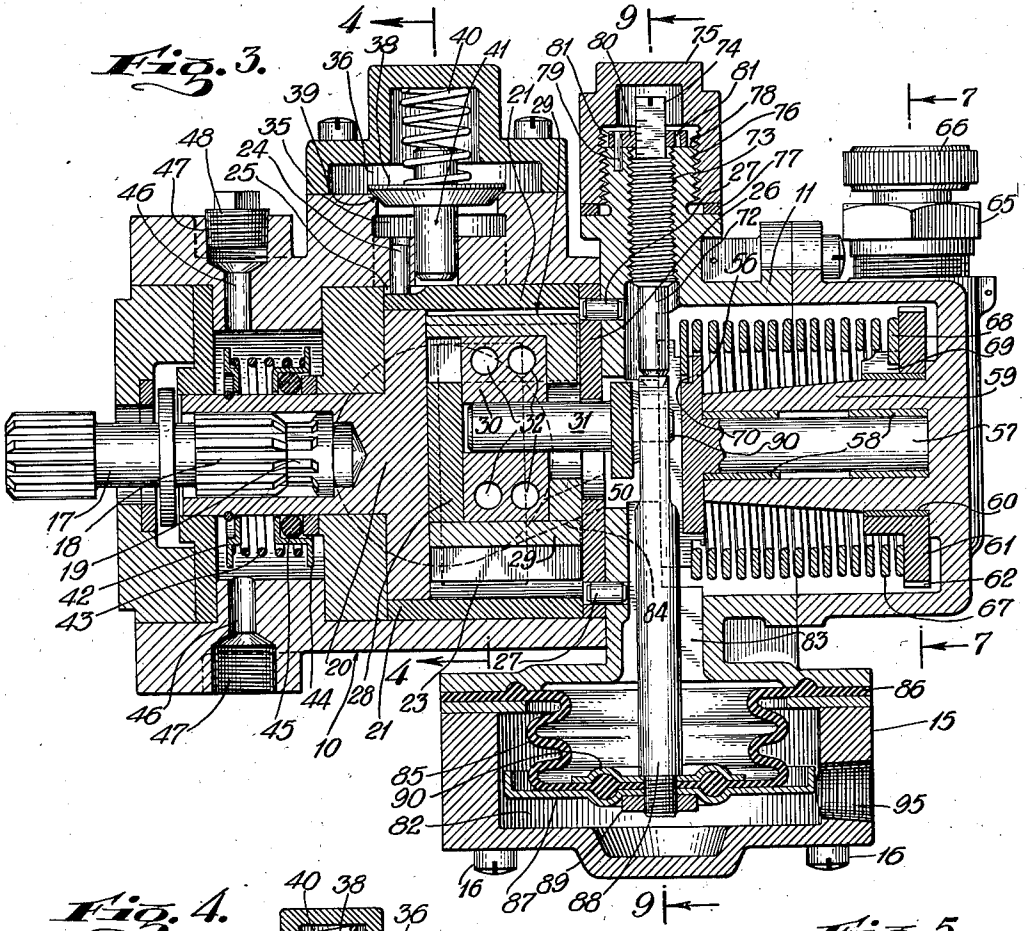


Fig. 4.

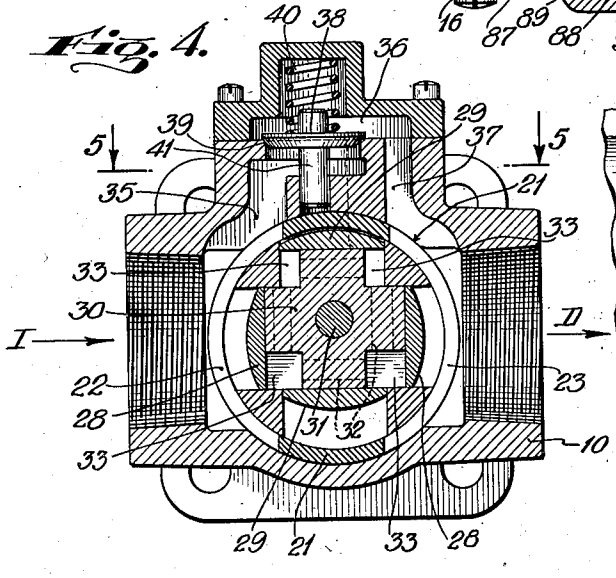
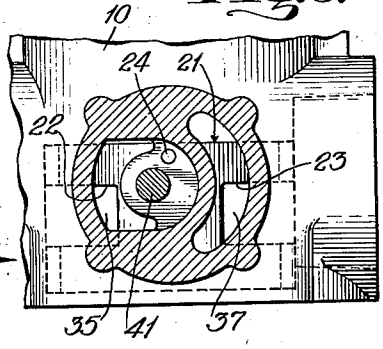


Fig. 5.



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Fig. 6.

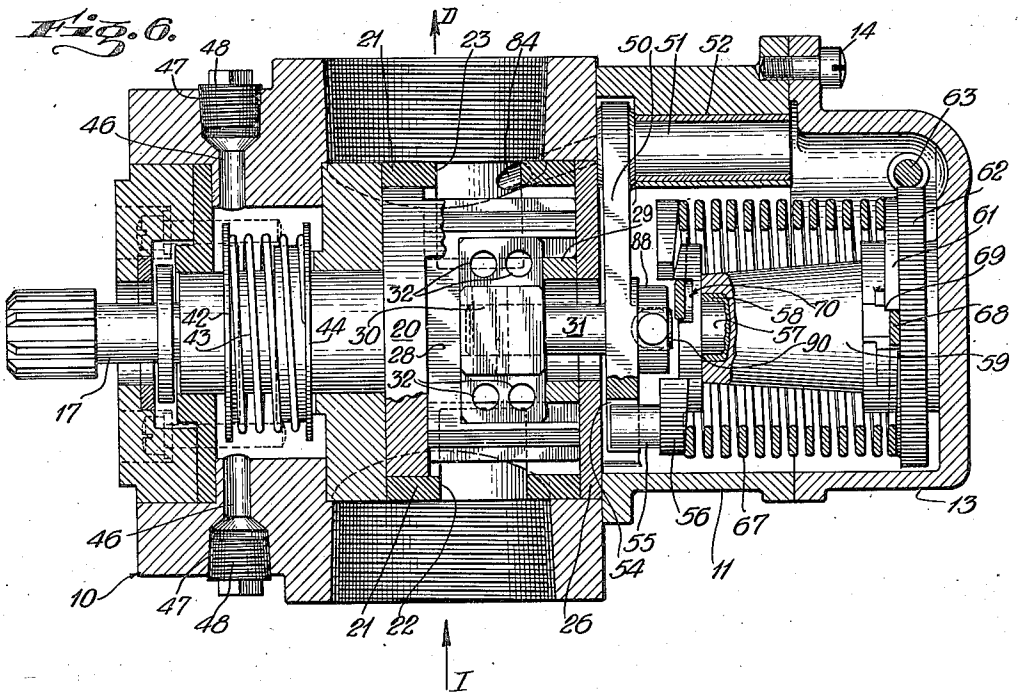
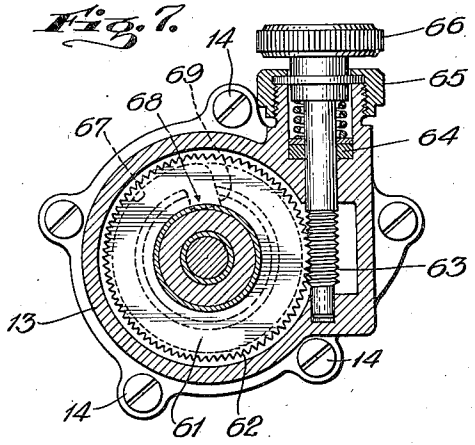


Fig. 7.



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Fig. 8.

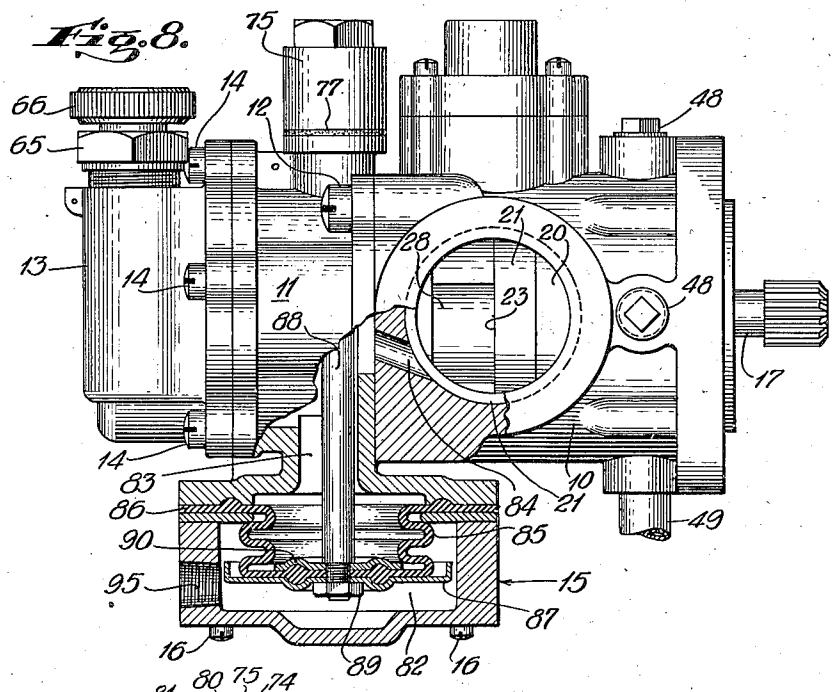


Fig. 9.

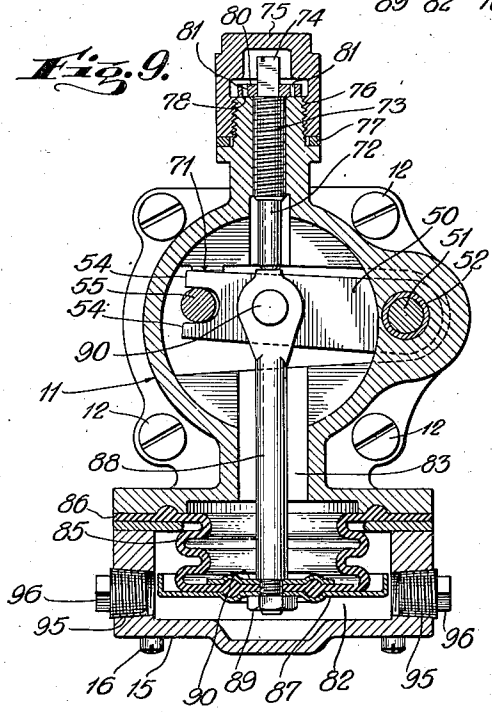
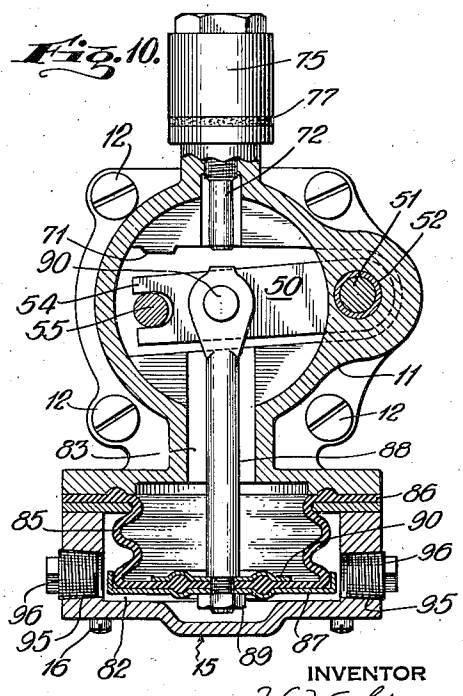


Fig. 10.



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UNITED STATES PATENT OFFICE

2,348,679

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Application March 14, 1941, Serial 383,258

23 Claims. (103—38)

This invention relates to a pump, and more particularly to a pump adapted for supplying gasoline to the carburetor of an airplane engine.

More particularly, my invention relates to a pump in which a positioning member is used for positioning certain of the pumping elements of the pump to vary the pumping volume, the positioning member in turn being preferably moved towards full pumping position by a spring, and away from pull pumping position by the pressure generated by the pump. It is an object of my invention to adapt such a pump for use in an airplane engine. It is known to those skilled in the art that in an airplane, a supercharger is utilized to supply air to the carburetor whereby to compensate for the decrease in atmospheric pressure as the airplane gains altitude. Since the pump supplies fuel directly to the carburetor at the pressure of the carburetor, the discharge pressure of the pump is of course superimposed on the air pressure at the carburetor, which pressure tends to remain at ground atmospheric because of the action of the supercharger.

Because in a variable volume pump of the class described, the discharge pressure acts against the force of a spring to reduce the volume pumped by the pump, the discharge pressure will have greater effect in decreasing the pumped volume as the airplane gains altitude, since the discharge pressure is superimposed on the pressure developed by the supercharger and acts against the decreased atmospheric pressure of high altitudes. This condition I have found undesirable, and to eliminate it, I apply the pressure generated by the supercharger of the airplane so as to compensate for its effect on the discharge pressure of the pump.

As a feature of my invention, I utilize a diaphragm against which the discharge pressure of the pump operates, this diaphragm being connected with the positioning member by novel means. As a further feature of my invention, it is against this diaphragm that the supercharger pressure is directed to compensate for its effect on the discharge pressure of the pump.

As a detailed feature of my invention, the diaphragm is secured with its open end about the periphery of a pressure chamber so as to effectively seal that pressure chamber from the inside of the diaphragm, the inside of the diaphragm being exposed through suitable passages to the discharge pressure of the pump. The pressure chamber is in communication with the supercharger, so that the pressure of the supercharger will act against the diaphragm in a direction directly opposite that of the discharge pressure of the pump.

As still a further feature of my invention, I utilize a diaphragm so mounted and so constructed as to increase its effective area as it operates, this being accomplished by me through a sidewise as well as endwise expansion of the diaphragm. This result is preferably obtained partially through the use of a diaphragm formed of a resilient rubber-like material, such as "Buna," which is resistant to deterioration by gasoline. Because the diaphragm is adapted for sidewise as well as endwise expansion, it is obvious that the action of the discharge pressure of the pump effects an increase in the area against which the discharge pressure may operate as the diaphragm is expanded. This increase of area results in an increase in the over-all pressure applied against the positioning member by the diaphragm, and compensates for the additional pressure of the spring or other pressure means against the positioning member as the positioning member is moved away from full pumping position by the pump discharge pressure acting against the diaphragm.

As a further feature of my invention, I use a novel arrangement of a torsion spring for pressing the positioning member to full pumping position, and a very novel manual means for adjusting the tension in said spring.

As still a further feature of my invention, I have a novel form of adjustable stop mechanism for limiting the throw of the positioning member towards full pumping position. In this way, I can readily predetermine the maximum throw of the positioning member and the maximum volume of the pump, it being understood that the pressure generated by the pump, if greater than that for which the spring is set, will force the positioning member away from its full pumping position.

As an additional feature of my invention, I arrange for a novel form of by-pass so that should the pump be rendered ineffective for some reason, it is possible to feed the gasoline to the carburetor through utilization of an auxiliary pump.

As a further feature of my invention, I use a shuttle block of novel form for actuating the pistons of my pump, this shuttle block being formed so as to facilitate its movement relatively to the rotor and pistons, all as will be indicated hereinafter.

I have thus described generally the important features of my invention in order that a better appreciation may be had of the detailed

description of those features which follows. One preferred form of the means which I have devised, is shown in the accompanying drawings, and will be described in this specification, but it should be understood that I consider my invention to be a relatively broad one, and that I expect to obtain claims which will prevent the utilization of my contribution to the art in physical forms other than that herein shown and described.

Referring now to the drawings, Fig. 1 is an elevation of a pump embodying my invention. Fig. 2 is a view looking downwardly on Fig. 1. Fig. 3 is a section of Fig. 2 taken along lines 3—3. Fig. 4 is a section taken along lines 4—4 of Fig. 3. Fig. 5 is a section taken along lines 5—5 of Fig. 4. Fig. 6 is a section along lines 6—6 of Fig. 1. Fig. 7 is a section taken along lines 7—7 of Fig. 3. Fig. 8 is a plan view from the side opposite Fig. 1 and broken away to show certain of the parts. Figs. 9 and 10 are taken along lines 9—9 of Fig. 3, and show certain of the parts in different operating positions.

Referring now more particularly to the drawings and especially to Figs. 1 and 2, it will be noted that the casing of my pump is built up of a series of separate castings held together by bolts. There is thus the casting 10 to which is secured the casing 11 by the bolts 12. The casing 13 is in turn secured to the casing 11 by the bolts 14. The casing 15 is in turn secured to the casing 11 by bolts 16. In describing my invention, I shall, for the purpose of simplicity, consider the pump casing as formed of a single casting.

Referring now more particularly to Figs. 3, 4 and 6, the drive shaft of my pump is designated by reference numeral 17, and has a splined connection 18, 19, with the rotor 20 of the pump. The rotor 20 rotates relatively to a lining 21 outlining a cylindrical chamber, and cut away at 22 for the intake side of the pump, and at 23 for the discharge side of the pump. As best illustrated in Fig. 3, a locating pin 24 fits into a slot 25 of the lining 21 and serves to maintain it in proper position. An endwise lining member 26 is also utilized, and is located by pins 27, all as is best seen from Fig. 3.

The rotor 20 is of the usual type formed with cross slots for the reciprocation of pistons 28 and 29 through the rotation of the rotor as the pistons are in contact with a cross-shaped eccentric shuttle block 30. The shuttle block 30 is maintained in varying eccentric positions by a pin 31 which is controlled in a manner to be hereinafter set forth. So far as I have described my rotor, its pistons and its shuttle block, they resemble structures well known in the art. A feature of novelty resides in the forming of bores 32 in the four arms of the shuttle block 30, these bores facilitating the flow of fluid from one side of the arms to the other as the shuttle block reciprocates relatively to the pistons. Thus, any fluid which enters between the shuttle block and the pistons, as within the spaces designated by reference numerals 33 in Fig. 4, may move freely from one side to the other of the arms of the shuttle block, all as will be fully appreciated by those skilled in the art.

It will be noted best from Fig. 4 that should the rotor 20 be held against rotation through some failure of the power which drives the pump or through some failure of the pump itself, and the pistons and shuttle block be held in their position of Fig. 4, no fluid will flow from the intake side of the pump to the discharge side, that is, in the direction of the two arrows I and D in Fig. 4, denoting respectively, intake and discharge. In an emergency of this sort, it is necessary that fluid be bypassed relatively to the rotor and its pistons, and for this purpose, I provide the casing with passages 35, 36 and 37, best shown in Figs. 4 and 5, which passages it will be noted, lead from the intake side of the pump to the discharge side. A valve 38 is seated as at 39 to prevent flow of fluid through the passages, and is held by the spring 40 against its seat 39, the valve being suitably guided by its stem portion 41. It is the function of the valve 38 to prevent any flow of fluid from the discharge side of the pump to the intake side of the pump when the pump rotor and pistons are operating normally. However, with the rotor and pistons not operating normally, fluid submitted under pressure against the rotor and pistons will act against the valve 38, moving it from its seat 39 against the force of the spring 40 so that gasoline may be forced through the passages 35, 36 and 37 to the discharge side of the pump, and thence to the carburetor, all as will be quite apparent to those skilled in the art.

A suitable mechanical seal is provided for the pump rotor, and is best illustrated in Figs. 3 and 6. This mechanical seal camprises a disk 42, a spring 43 and a further disk 44, as well as the ring packing 45. I do not believe a further description of the construction of my seal is necessary, since I do not claim any particular novelty therein.

For disposing of any gasoline which may leak past the mechanical seal described, the casing is formed with four bores 46, terminating in threaded counter bores 47. In normal use, all but one of the bores 46 and the counterbores 47 will be plugged by screw threaded plugs 48. The lowermost bore 46, depending upon the position of the pump unit when assembled in the airplane, will have leading therefrom a pipe 49, as best shown in Fig. 1, the pipe returning to the gasoline supply line such fuel as may leak past the mechanical seal. The utility of this construction will of course be readily understood by those skilled in the art.

As was indicated earlier in the specification, the eccentricity of the shuttle block 30 is determined by a shuttle pin 31. I shall now describe the means whereby the eccentricity of the shuttle pin is itself determined in accordance with the setting of a spring, and in further response to the discharge pressure, with the variations in atmospheric pressure compensated for by a supercharger.

Referring now more particularly to Figs. 3, 6, 9 and 10, and especially to Fig. 6, it will readily be noted that the pin 31 forms part of a lever 50 which through a shaft portion 51 integral therewith, is pivoted to the casing through the intermediary of a bushing 52. The lever 50 is bifurcated as at 54 for cooperation with a pin 55 extending laterally from a disk 56. The disk 56 has an integral shaft portion 57, best seen in Fig. 3, whereby it is rotatably mounted on bushings 58 relatively to a bored abutment 59 formed as a part of the pump casing. Mounted about the outside of the abutment 59 through the intermediary of the bushing 60 is what I term a spring winding disk 61, which as best illustrated in Fig. 7, has teeth 62 formed on its periphery for cooperation with the worm shaft 63. The

shaft 63 extends outwardly of the casing through a suitable seal 64 and a cap 65, and is formed with a knob 66 whereby the shaft 63 may be rotated. Its rotation in turn, of course, rotates the disk 61 to adjust the tension in a spring 67 positioned between the disk 56 and the spring winding disk 61.

One end of the spring 67, seen best in Fig. 7 and there designated by reference numeral 68, fits into a suitable notch 69 in the spring winding disk 61 whereby rotation of the disk winds the spring. The other end of the spring 67, as best seen in Fig. 6, fits into a notch 70 in the disk 56 and tends therefore to rotate the disk in accordance with the pressure predetermined by the torsion of the spring 67. It is obvious that the spring 67 will tend to rotate the disk 56, and therefore through the pin 55, rotate the lever 50 in a clockwise direction, looking at Figs. 9 and 10. When so rotated, the lever 50 and its shuttle pin 31 will position the shuttle block 30 in an eccentric pumping position. The most extreme eccentric position to which the lever 50, and therefore the shuttle block 30, may be moved, is determined by a shoulder 71 formed on the casing and limiting the throw of the lever 50.

Should less than maximum volume be desired, a movable stop may be utilized, this stop taking the form of a shaft 72 which has threads at 73 for threaded engagement with the casing of the pump. The shaft 72 extends outwardly through the casing, and is equipped with a square head 74 for ready manual adjustment, as is probably best seen in Figs. 3 and 9. A cap 75 is threaded on to the casing as at 76 for normally preventing access to the shaft 72 and its head 74, a suitable seal 77 being provided between the cap 75 and the casing. For maintaining the shaft 72 in any position to which it is adjusted, the end surface 78 of the casing through which the shaft 72 extends, has projecting therefrom a pin 27, with which may cooperate any one of the holes 81 of a disk 80 which is slidable on the square end portion 74 of the shaft, and which must rotate with the disk. Those skilled in the art will readily appreciate that when the disk 80 is moved endwise to remove a hole 81 from the pin 79, the shaft 72 may be rotated, after which, by moving the disk 80 until another hole 81 thereof fits over the pin 79, the shaft is locked in a particular adjusted position. It will now be readily understood that through rotation of the shaft 72, the maximum volume of the pump, dependent on the maximum eccentricity which may be imparted to the shuttle block 30, may be predetermined.

Referring now to Figs. 3, 9 and 10, it will be noted that my casing includes what I term a pressure chamber 82 which is in communication through passages 83 and 84 (Figs. 6 and 8) with the discharge side of the pump. The pressure chamber 82 is effectively formed in two parts sealed from one another by a diaphragm 85 secured at 86 relatively to the casing through the joining together of the casting 15 of the casing and the casting 11 by the series of bolts 16, as has already been described. The diaphragm 85 is preferably formed of a rubber substitute, such as "Buna," which is resistant to deterioration by gasoline, and is secured at its pressure end relatively to a cup-shaped plate 87 and the threaded end of a rod 88, through the intermediary of a nut 89 and a circular plate 90. The shapes of the plates 87 and 90 and the means whereby the diaphragm is secured to those plates and the rod 88, are very clearly shown in the several drawings, and need not be further described here.

It is obvious from a study of the parts in Figs. 3 and 9, that the diaphragm 85 is capable of expanding sidewise as well as endwise. This it does upon the application of pressure thereto, and assumes a position such as that of Fig. 10, when the discharge pressure is sufficiently great to overcome the pressure of the spring 67 maintaining the parts in the position of Figs. 3 and 9. The rod 88 is pinned at 90 to the lever 50 so that the movement of the diaphragm to the position of Fig. 10 will force the lever 50 to the position of Fig. 10 against the force of the spring 67. This effects a movement of the shuttle block 30 through its pin 31 from the eccentric position which is predetermined by the positioning of the limit shaft 72, and cuts down the volume which will be pumped by the rotor 20 and its pistons. Thus, if the throttle is closed and less gasoline is required by the carburetor, the pressure on the discharge side of the pump will increase and will act on the diaphragm moving it from the position of Fig. 9 toward the position of Fig. 10, to decrease the eccentricity of the shuttle block 30 and the pump volume.

Those skilled in the art will readily appreciate that in moving from the position of Fig. 9 to the position of Fig. 10, the lever 50 acts through the pin 55 to wind the spring 67, thereby increasing the effective pressure which is transmitted by the spring. Since it is the initial pressure setting of the spring which determines the maximum pressure at which a predetermined volume is pumped, and since it is desirable that the pressure acting on the diaphragm 85 shall be in a predetermined proportion at all times to the force of the spring 67, I utilize the sidewise expansion of the diaphragm to apply therethrough an increasingly greater pressure as the rod 88 secured to the diaphragm moves the lever 50 and winds the spring 67. Thus, it will be appreciated that in Fig. 10, the section of the diaphragm against which the discharge pressure of the pump acts, is greater than it is in Fig. 9, so that the total pressure exerted by the diaphragm is also greater, and compensates for the greater tension in the spring. This particular feature of my invention I consider of considerable importance.

That portion of the pressure chamber 82 outside the diaphragm 85 has formed therein a series of threaded openings 95. It will be well to consider what would happen were these openings allowed to remain open and exposed to the atmosphere. As the airplane gains altitude, the decrease in atmospheric pressure on the carburetor is compensated for by a supercharger, so that the fluid pressure developed by the pump is superimposed on the supercharger pressure, rather than on the decreased atmospheric pressure. It is this compensated fluid pressure, as we may call it, which is applied against the inside of the diaphragm 85 to move the shuttle block 30 to decrease the pumping volume. Since this compensated fluid pressure, at high altitudes, operates against a decreased atmospheric pressure on the outside of the diaphragm 85, the pumping volume will be decreased to a greater degree than is desirable. To offset this phenomenon, I connect the supercharger to the pressure chamber through at least one of the threaded openings 95, closing the others with plugs 96.

It is quite clear that with such an arrangement, the compensated fluid pressure always acts against a compensated atmospheric pressure on the outside of the diaphragm 85 so that it is the increased fluid pressure only which really acts to cut down the pump volume. It is thought that in view of the several general explanations previously presented and the specific description now presented, this feature of the invention which is highly important, will be fully appreciated and understood.

I now claim:

1. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a spring for pressing said positioning member into a predetermined volume position, an expansible and contractible diaphragm, said pump having passages connecting the discharge pressure of said pump to said diaphragm whereby said pressure acts against the diaphragm to expand it, means whereby the diaphragm effects the movement of said positioning member against the pressure of said spring toward non-pumping position, and means mounting said diaphragm so that the effective area thereof against which said discharge pressure is applied increases through the deforming of said diaphragm as said positioning member is moved by said diaphragm against the pressure of said spring whereby to compensate for the increasing pressure of said spring.

2. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a spring for pressing said positioning member into a predetermined volume position, an expansible and contractible diaphragm, said pump having passages connecting the discharge pressure of said pump to said diaphragm whereby said discharge pressure acts against the diaphragm to expand it, means connecting the diaphragm to said positioning member for moving said member against the pressure of said spring toward non-pumping position, and means mounting said diaphragm for sidewise as well as endwise expansion by said discharge pressure so that the effective area thereof against which said discharge pressure is applied increases by said sidewise expansion as said positioning member is moved by said diaphragm against the pressure of said spring whereby to compensate for the increasing pressure of said spring.

3. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a spring for pressing said positioning member into predetermined volume position, an expansible and contractible diaphragm formed of a flexible resilient material such as rubber adapted when expanded as by the application of pressure thereto to increase the effective area against which the pressure acts to further expand said diaphragm, said pump having passages connecting the discharge pressure of said pump to said diaphragm whereby said discharge pressure acts against the diaphragm to expand it, means connecting the diaphragm to said positioning member for moving said member against the pressure of said spring toward non-pumping position as said diaphragm is expanded, the increase of the size of said effective area as said diaphragm is expanded acting to increase the effective area against which said discharge pressure is applied as said positioning member is moved against the pressure of said spring, whereby to compensate for the increasing pressure of said spring.

4. In a pump of the class described comprising a casing, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a spring for pressing said positioning member into a predetermined volume position, a movable stop in said casing against which said spring presses said positioning member whereby said movable stop determines said volume position, said stop comprising a shaft in screw threaded relation to said pump casing whereby rotation thereof adjusts said stop, and a portion of said shaft extending outwardly of said casing for manual manipulation.

5. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a torsion spring, means whereby said positioning member is secured relatively to one end of said spring whereby to be pressed into a predetermined volume position, and means secured to the other end of said spring for winding said spring and determining the pressure under which said positioning member is urged to said predetermined volume position.

6. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a torsion spring, means whereby said positioning member is secured relatively to one end of said spring whereby to be pressed into a predetermined volume position, a rotatable adjusting member secured to the other end of said spring for winding said spring and determining the pressure under which said positioning member is urged to said predetermined volume position, and means for rotating said adjusting member and for maintaining it in adjusted position.

7. In a pump of the class described, a positioning lever for a pump mechanism adapted to determine the volume pumped by said mechanism, a torsion spring, a disk secured to one end of said spring, a connection between said disk and lever whereby said spring urges said lever toward a predetermined volume position, and a winding disk secured to the other end of said spring for winding said spring and determining the torsion therein and therefore the pressure under which said lever is urged by said spring to said predetermined volume position.

8. In a pump of the class described, a positioning lever for a pump mechanism adapted to determine the volume pumped by said mechanism, a torsion spring, a disk secured to one end of said spring, a connection between said disk and lever whereby said spring urges said lever toward a predetermined volume position, an adjustable stop against which said spring presses said lever to determine said volume position, and a winding disk secured to the other end of said spring for winding said spring and determining the torsion therein and therefore the pressure under which said lever is urged by said spring to said predetermined volume position.

9. In a pump of the class described, a positioning lever for a pump mechanism adapted to determine the volume pumped by said mechanism, a torsion spring, a disk secured to one end of said spring, a connection between said disk and lever whereby said spring urges said lever toward a predetermined volume position, an expansible and contractible diaphragm, said pump having passages connecting the discharge pres-

sure to said diaphragm whereby said pressure acts against the diaphragm to expand it, means connecting the diaphragm to said positioning lever for moving said lever against the pressure of said spring toward non-pumping position, and a winding disk secured to the other end of said spring for determining the torsion therein and therefore the pressure under which said lever is urged by said spring to said predetermined volume position.

10. In a pump of the class described, a positioning lever for a pump mechanism adapted to determine the volume pumped by said mechanism, a torsion spring, a disk secured to one end of said spring, a connection between said disk and lever whereby said spring urges said lever toward a predetermined volume position, an expansible and contractible diaphragm, said pump having passages connecting the discharge pressure to said diaphragm whereby said pressure acts against the diaphragm to expand it, means connecting the diaphragm to said positioning lever for moving said lever against the pressure of said spring toward non-pumping position, a winding disk secured to the other end of said spring for determining the torsion therein and therefore the pressure under which said lever is urged by said spring to said predetermined volume position, and a hand rotated shaft having a worm gear connection with the periphery of said disk for rotating said disk into a particular spring torsioning position and thereafter maintaining the said spring in that position.

11. In a pump of the class described, a rotatably mounted positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a torsion spring, a connection between said spring and member whereby said spring rotates said member toward a predetermined volume position, an expansible and contractible diaphragm, said pump having passages connecting the discharge pressure of said pump to the interior of said diaphragm whereby said pressure acts against the diaphragm to expand it, means connecting the diaphragm to said positioning member for moving said member against the pressure of said spring toward non-pumping position, and a pressure chamber formed with the exterior of said diaphragm defining part thereof whereby said diaphragm may be subjected to pressure to offset said pump fluid pressure.

12. In a pump of the class described, a rotor, a pair of reciprocating pistons carried by said rotor and slidable relatively thereto and to one another, an eccentrically positioned shuttle block having four arms in the form of a square cross and having the opposed parallel surfaces of its arms in contact with said pistons for reciprocating said pistons as said rotor is rotated to contribute a pumping effect, said block sliding relatively to said pistons while reciprocating said pistons, an eccentric pin for determining the eccentricity of said shuttle block, and passages through the arms of the said shuttle block to allow the passage of fluid as said block slides relatively to said pistons.

13. In a pump of the class described, a casing, a rotary pump mechanism in said casing, a positioning lever for said pump mechanism pivoted in said casing and adapted to determine the volume pumped by said mechanism, a spring chamber having a torsion spring therein, a rotary shaft in said spring chamber and extending outwardly thereof for manual adjustment, means whereby said shaft adjusts the torsion of said spring, means of connection between said spring and lever whereby said spring rotates said lever in one direction corresponding to full pumping of said pump mechanism, an adjustable stop against which said lever is pressed by said spring, said stop extending outwardly of said casing for manual adjustment, a rod pivotally secured to said lever at one end, a pressure diaphragm to which said rod is secured at its other end, said pump having passages connecting the pressure side of said pump with the interior of said diaphragm whereby said pressure acts against said diaphragm to move said lever against said spring toward non-pumping position, and a chamber in which the outside of said diaphragm is exposed for the application of pressure to offset said fluid pressure.

14. In a pump of the class described, a rotatably mounted positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a torsion spring, means whereby said positioning member is secured relatively to one end of said spring whereby to be rotated into a predetermined volume position, and means secured to the other end of said spring for winding said spring and determining the pressure under which said positioning member is rotated to said predetermined volume position.

15. In a pump of the class described, a rotatably mounted positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a torsion spring, means of connection between said spring and member whereby said spring rotates said member toward a predetermined volume position, an expansible and contractible diaphragm, said pump having passages connecting the discharge pressure to said diaphragm whereby said discharge pressure acts against the diaphragm to expand it, means whereby the diaphragm urges the rotation of said positioning member against the pressure of said spring toward non-pumping position when the discharge pressure is applied thereagainst, and a winding means secured to a portion of said spring for determining the torsion therein and therefore the pressure under which said positioning member is rotated by said spring toward said predetermined volume position.

16. In a pump of the class described, a rotor, a pair of reciprocating pistons carried by said rotor and slidable relatively thereto and to one another, an eccentrically positioned shuttle block having four arms in the form of a square cross and having the opposed parallel surfaces of its arms in contact with said pistons for reciprocating said pistons as said rotor is rotated to contribute a pumping effect, said block sliding relatively to said pistons while reciprocating said pistons, and passages through the arms of the said shuttle block to allow the passage of fluid as said block slides relatively to said pistons.

17. In a pump of the class described, a rotor, a reciprocating piston carried by said rotor and slidable relatively thereto to contribute a pumping action, an eccentrically positioned shuttle block having surfaces adapted to contact opposed surfaces formed on said piston for reciprocating said piston relatively to said rotor as said rotor is rotated, said shuttle block sliding relatively to said piston surfaces while reciprocating said piston, and passages through said shuttle block to allow the passage of fluid from one side to the

other of said shuttle block as it slides relatively to said surfaces.

18. In a pump of the class described, a rotor, a reciprocating piston carried by said rotor and slidable relatively thereto to contribute a pumping action, an eccentrically positioned shuttle block positioned within a slot formed in said piston and contacting opposed surfaces of the said piston defining the said slot for reciprocating said piston relatively to said rotor as said rotor is rotated, said shuttle block sliding relatively to said surfaces while reciprocating said piston, and passages through said shuttle block to allow the passage of fluid from one side to the other of said shuttle block as it slides relatively to said surfaces.

19. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a spring for pressing said positioning member into a predetermined volume position, an expansible and contractible diaphragm of cup shape having a bottom portion and a side portion and with said side portion adapted to extend into said bottom portion as said diaphragm is expanded, said pump having passages connecting the discharge pressure of said pump to said diaphragm whereby said pressure acts against the bottom portion of said diaphragm to expand said diaphragm and thereby to increase the area of its bottom portion, means whereby the expansion of said diaphragm effects the movement of said positioning member against the pressure of said spring toward non-pumping position, the increase of the area of said bottom portion acting to increase the effective area against which said discharge pressure is applied as said positioning member is moved against the pressure of said spring, whereby to compensate for the increasing pressure of said spring.

20. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a spring for pressing said positioning member into a predetermined volume position, a cupshaped expansible and contractible diaphragm having a bottom portion and a side portion, a metal plate against which the bottom portion of said cupshaped diaphragm presses when acted upon by fluid pressure, said plate being somewhat larger than the normal area of the bottom of the diaphragm, the application of fluid pressure to said diaphragm acting to expand said diaphragm and to force the side thereof to move against said plate to form in effect a part of the bottom thereof whereby to increase the area of the bottom of said diaphragm, said pump having passages connecting the discharge pressure of said pump to said diaphragm whereby said discharge pressure acts against the diaphragm to expand it, and means connecting the bottom of said diaphragm and said plate portion to said positioning member for moving said positioning member against the pressure of said spring toward non-pumping position as said diaphragm is expanded.

21. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, an expansible and contractible diaphragm, said pump having passages connecting the discharge pressure of said pump to said diaphragm whereby said pressure acts against the diaphragm to expand it, means whereby the diaphragm effects the movement of said positioning member, and means mounting said diaphragm so that the effective area thereof against which said discharge pressure is applied increases through the deforming of said diaphragm as said positioning member is moved by said diaphragm.

22. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, an expansible and contractible diaphragm having a bottom portion and a side portion and with said side portion adapted to extend into said bottom portion as said diaphragm is expanded, said pump having passages connecting the discharge pressure of said pump to said diaphragm whereby said pressure acts against the bottom portion of said diaphragm to expand said diaphragm and thereby to increase the area of its bottom portion, means whereby the expansion of said diaphragm effects the movement of said positioning member, the increase of the area of said bottom portion acting to increase the effective area against which said discharge pressure is applied.

23. In a pump of the class described, a positioning member for a pump mechanism adapted to determine the volume pumped by said mechanism, a cupshaped expansible and contractible diaphragm having a bottom portion and a side portion, a metal plate against which the bottom portion of said cupshaped diaphragm presses when acted upon by fluid pressure, said plate being somewhat larger than the normal area of the bottom of the diaphragm, the application of fluid pressure to said diaphragm acting to expand said diaphragm and to force the side thereof to move against said plate to form in effect a part of the bottom thereof whereby to increase the area of the bottom of said diaphragm, said pump having passages connecting the discharge pressure of said pump to said diaphragm whereby said discharge pressure acts against the diaphragm to expand it, and means connecting the bottom of said diaphragm and said plate portion to said positioning member for moving said positioning member.

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